

AD No. 331112
ASTIA FILE COPY

The A. & M. College of Texas

DEPARTMENT OF OCEANOGRAPHY



TRANSFER PROCESSES OPERATING AT THE OCEAN BOUNDARIES

Navy Department
Office of Naval Research
Contract N7 onr-48704

Project NR 083-071
Final Report
May, 1954

A&M Project 30 — Reference 54-38F

Robert O. Reid and William H. Clayton

Research Conducted through the
Texas A. & M. Research Foundation
COLLEGE STATION, TEXAS



THIS REPORT HAS BEEN DELIMITED
AND CLEARED FOR PUBLIC RELEASE
UNDER DOD DIRECTIVE 5200.20 AND
NO RESTRICTIONS ARE IMPOSED UPON
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE,
DISTRIBUTION UNLIMITED.

THE AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
Department of Oceanography
College Station, Texas

Research conducted through the
Texas A & M Research Foundation
in cooperation with the
Gulf Coast Division
of the Sun Oil Company

A&M Project 30 - Reference 54-38F

FINAL REPORT FOR
PERIOD MARCH 15, 1951 - APRIL 30, 1954

Project 30 is a study of transfer processes operating at the ocean boundaries sponsored by the Office of Naval Research (Project NR 083-C71, Contract N7onr-48704). Presentation of material in this report is not considered to constitute final publication.

Report Prepared
by
Robert O. Reid and William H. Clayton

May , 1954

TASK ORDER

The Contractor shall furnish the necessary personnel and facilities for and, in accordance with any instructions issued by the Scientific Officer or his authorized representative, shall conduct a continuous observation and analysis program on the oceanography and meteorology of the Gulf of Mexico from a stationary platform. Such research shall include, but not necessarily be limited to:

- (1) a continued series of observations of currents, waves, tides, winds, and sea and air temperatures, as well as temperatures in the bottom muds;
- (2) an investigation of the processes operating in shallow water;
- (3) development of the theoretical effects of wind stress on the water surface; and
- (4) an evaluation of the effect of very high winds in shallow water with short fetches.

Instrument Program at Pure Oil Platform

Texas A & M Research Foundation Project 30 began its data collection program as directed by the task order in May 1951. The nucleus of this program was formed from an instrument station previously operated by another contract concerned with the analysis of marine pipe line problems. This station, while adequate to the pipe line project, was far too limited in scope to allow attainment of the objectives of this project. Consequently, the major project effort during the first fifteen to eighteen months of the contract was devoted to the establishment of a suitable measuring program. This phase has been reviewed in detail in the first annual report and subsequent status reports.

Analyses during this period were directed towards two main topics: correlation of meteorological activity with sea level oscillations, and evaluation of wind stress under varying oceanographic and meteorological conditions. These topics have continued to receive most of the attention in regard to the analytic endeavors of the project. The investigation of long surges in shallow water was given added stimulus by the addition of Dr. B. W. Wilson to the staff of the Department of Oceanography. In this connection it was felt desirable to afford some support to his efforts on behalf of the project to allow completion of his research in connection with surging in Table Bay, Cape Town. Results of these various studies are reviewed in technical reports and publications of the project. (Listed at end of this report).

In June of 1952, the related instrumental procedures and requirements of Project 38 (a study of wave forces on pilings, sponsored by the Navy Department, Bureau of Yards and Docks) made field coordination

of the two projects desirable and their efforts were merged. Close cooperation between projects has continued to the present.

In January of 1953, a fire involving the gas wells on the off-shore platform, from which the collection program was being conducted, resulted in complete disruption of this program. While actual equipment loss was not extensive, a great amount of time was needed for re-establishment. Nevertheless, it was felt necessary to continue the measuring program at a new site so as to adequately supplement the data taken at the Pure platform prior to the fire.

It was originally planned to publish all data collected as a ready source of information to other interested investigators, and three such reports were prepared which covered most of the data collected at the Pure Oil site. It was later decided that the cost and effort expended in the preparation of such reports could be better expended in the measuring and analytical phases, and further issuance of data reports was discontinued.

Operations at the Sun Oil Pier

In April of 1953, the use of an instrument site on the Texas coast was obtained by the Texas A & M Research Foundation from the Sun Oil Company. The new site, a half mile pier near Caplen, Texas, is well suited for the purpose and permits the close supervision not possible at the previous site.

Reinstallation of the measuring program was begun in June of 1953, and is now complete except for special instrumentation. Technical reports covering various measuring systems are now in preparation or have been distributed.

Continuation of Objectives

Although the contract formerly terminated on April 30 of this year, work is continuing on a limited basis under a different task order (N7onr-48702). The collection phase for the current year will continue on approximately the same scale as originally planned under the previous task order. The types of data to be collected and the general principles of measurement are listed below:

- temperature at twelve points within the air, water, and muds (copper-constantan thermocouples);
- water stage (stilwell and float);
- water level set-up (two stillwells with the floats coupled to synchro-repeaters);
- wind speed (three cup anemometer);
- wind direction (standard wind vane modified for synchro operation);
- surface and bottom salinity (electrical conductivity);
- wave heights and periods over same horizontal increment used for water level set-up (dynamic pressure);
- wave heights and periods (step-gage);
- solar radiation (pyrheliometer);
- total radiation absorbed by unit area of sea surface per unit time (radiometer);
- precipitation (rain gage);
- humidity (hygrograph);
- atmospheric pressure (microbarograph); and
- currents (Price Meter).

The investigation of wind stress effects will be continued. An attack on this problem using wind gradient measurements and the Prandtl theory, and reviewed in the second annual report, was not conclusive and

has been abandoned in favor of determination of water slope under various environmental conditions. This study, which will be used as the dissertation subject for the Ph. D. degree by Mr. William H. Clayton of this project, is scheduled for completion during the current contract year. The objectives of this study, as contained within the dissertation proposal are: to determine by direct measurement, at two points over a limited fetch within the Gulf of Mexico, the magnitude of wind tides; to ascertain what portions of the tide are due to tangential and normal stresses under different conditions of wind speed and initial surface perturbation; to evaluate certain fundamental parameters postulated by theoretical considerations of the problem; and to formulate a general expression applicable to the prediction of set-up in a basin subject to near uniformity of the meteorological and oceanographic environment.

Several technical reports are planned for the current contract year. These will cover special measuring techniques and instruments developed by the project as well as results of the various analyses of collected data. It should be borne in mind that this planned release of reports is quite tentative. It has been necessary to considerably reduce the activities of the project during the past few months, and funds for personnel beyond that required to operate the collection and processing stages are limited.

Reports

A list of reports and publications of this project are given below. This includes technical reports, publications, presentation of papers (not yet published) at National societies, and also two master's theses which have not been issued in report form but are available on

loan from the Texas A. & M. Library. The latter were prepared as a direct or indirect result of the students' employment on the project.

An attempt has been made to categorize these reports and publications in regard to the technical material presented according to the itemized list of objectives in the task order of this project. These categorical numbers are given in parentheses at the right of each entry.

PUBLICATIONS AND REPORTS PREPARED IN CONNECTION WITH
CONTRACT N7onr-48704*

First Annual Report, Robert O. Reid and William H. Clayton, April 1952. (1,2)
(Includes technical discussion of instrumentation).

Data Report, Section I (Temperature Data at Pure Oil Site), December, 1952.)

Data Report, Section II (Water Level Data at Pure Oil Site), December, 1952.) (1)

Data Report, Section III (Wind Velocity Data at Pure Oil Site), December, 1952.)

A Comprehensive Review of the Theories of Vertical Distribution of Horizontal Velocity in the Turbulent Boundary Layer of the Atmosphere, Owen S. Lee, January, 1953. (M. S. Thesis, Texas A. & M. College). (2)

Generation of Long Period Seiches in Table Bay, Cape Town, by Barometric Oscillations, Basil W. Wilson. Presented at the American Geophysical Union Meeting in Washington, D. C., May, 1953. (2)

Changes in Wave Height Due to Bottom Friction, Percolation, and Refraction, Charles L. Bretschneider and Robert O. Reid. Presented at the American Geophysical Union Meeting in Washington, D. C., May, 1953. (2)
This was under the joint sponsorship of the Beach Erosion Board (Contract DA-49-055-eng-18) and Office of Naval Research (Contract N7onr-48704). (Report in preparation).

On the Theory of Water Level Variations in Lakes and Seas Induced by Atmospheric Disturbances, Carter R. Sparger, August, 1953. (M. S. Thesis, Texas A. & M. College). (2)

Table Bay as an Oscillating Basin, Basil W. Wilson. Presented at Minnesota International Hydraulics Convention in Minneapolis, Minnesota, September, 1953. (2)

Second Annual Report, Robert O. Reid and William H. Clayton, October 1953. (Includes technical discussion of wind profiles). (2)

The Mechanism of Seiches in Table Bay Harbour, Cape Town, Basil W. Wilson. Published in the Proceedings of Fourth Conference on Coastal Engineering, October, 1953, pp. 52-78. (2)

* Does not include status reports.

The Design Wave in Deep or Shallow Water, Storm Tide, and Forces on Vertical Piling and Large Submerged Objects, Robert O. Reid and Charles L. Bretschneider. A Technical Report prepared under Contract Nos. NOy-27474, DA-49-055-eng-18, and N7onr-48704. October, 1953. (2,3,4)

Development of a Step-Type Wave Recorder, Technical Report 30-1, William H. Clayton, December, 1953. In conjunction with NOy-27474. (1)

Formation of Surges in an Enclosed Basin or Partially Enclosed Basin by a Moving Atmospheric Disturbance, Robert O. Reid. Presented at the American Meteorological Society Meeting in Baltimore, Maryland, April 30, 1954. (3)

Harbour Surging at Cape Town, South Africa, Basil W. Wilson. Published in The Dock and Harbour Authority, March, 1954, pp. 329-332. (2)

PERSONNEL

Personnel at End of Contract N7onr-48704

Robert O. Reid, Project Supervisor
William H. Clayton, Associate in Oceanography
Mary E. Gambill, Secretary-Computer
Eddie Jo Hoffman, Computer, part-time
Johnny E. Slenk, Student Assistant, part-time

Personnel Previously Employed at Different Stages of Project

S. Elaine Ashburn, Computer
Ann A. Barr, Computer
Joe C. Bradley, Computer
John E. Conner, Draftsman-Computer
Joe S. Creager, Research Assistant
Gretchen A. Duncan, Computer
Richard A. Forgrave, Marine Technician
Leonard I. Holder, Research Assistant
Helen M. Jacobs, Computer
Minton J. Kelly, Engineer
Arch B. Kennedy, Jr., Marine Technician
Owen S. Lee, Research Assistant
Marvin R. Mace, Marine Technician
W. Dean McBride, Computer
Frank W. Moon, Research Assistant
Marion L. Proctor, Stenographer
Betty O. Robbins, Senior Computer
Carter R. Sparger, Research Assistant
Nancy A. Stevens, Computer
Max H. Tanner, Technical Assistant
Doyle M. Thomas, Draftsman-Computer
Basil W. Wilson, Associate Oceanographer

kind

DISTRIBUTION LIST

<u>No.</u> <u>Copies</u>	<u>Addressee</u>	<u>No.</u> <u>Copies</u>	<u>Addressee</u>
1	Bingham Oceanographic Foundation Yale University New Haven, Connecticut	1	Project AROWA U. S. Naval Air Station Bldg. R-48 Norfolk, Virginia
1	Director Virginia Fisheries Laboratory College of William and Mary Gloucester Point, Virginia	1	Director Alabama Marine Laboratory Bayou La Batre, Alabama
8	U. S. Navy Hydrographic Office Washington 25, D. C. Attn: Division of Oceanography	1	U. S. Navy Underwater Sound Lab. Attention: Dr. Marsh New London, Connecticut
1	Director Institute of Fisheries Research University of North Carolina Morehead City, North Carolina	1	Librarian, Wayne A. Kalenich Southwest Research Institute 8500 Culebra Road San Antonio 6, Texas
1	Institute of Engineering Research 244 Hesse Hall Berkeley 4, California Attn: Prof. J. W. Johnson	1	Director University of Florida Marine Biological Station Gainesville, Florida
1	Head, Dept. of Meteor. & Ocn. New York University New York, New York	1	Director Duke University Marine Lab. Beaufort, North Carolina
1	Southern Regional Education Board Marine Sciences 830 W. Peachtree St., N.W. Atlanta, Georgia	1	Director Louisiana State University Marine Laboratory Baton Rouge, Louisiana
1	Department of Aerology U. S. Naval Post Graduate School Monterey, California	1	Director Bear's Bluff Laboratories Wadmalaw Island, South Carolina
1	Director Marine Laboratory of Texas Game & Fish Commission Rockport, Texas	1	Geophysical Laboratory of Department of Geology Columbia University New York, N. Y.
2	Officer-in-Charge Office of Naval Research London Branch Office Navy No. 100, Fleet P. O. New York, N. Y.	1	U. S. Weather Bureau Department of Commerce Washington 25, D. C. Attn: Scientific Services
1	U. S. Fish & Wildlife Service Fort Crockett Galveston, Texas	1	National Bureau of Standards Washington 25, D. C. Attn: Dr. G. H. Keulegan Hydraulics Section

DISTRIBUTION LIST

<u>No.</u> <u>Copies</u>	<u>Addressee</u>	<u>No.</u> <u>Copies</u>	<u>Addressee</u>
1	Gulf State Marine Fisheries Comm. Audubon Bldg. 931 Canal Street New Orleans 16, La. Attn: Dukley Gunn, Exec. Sec'y	1	Mr. G. S. Vincent, Dep't of Com. Bureau of Public Roads Structural Research Lab. University of Washington Seattle 5, Washington
1	The Library Univ. of British Columbia Vancouver 8, Canada	1	Director Gulf Coast Research Lab. Ocean Springs, Mississippi
1	Chief, Bureau of Yards & Docks Navy Department Washington 25, D. C.	1	Dr. Willard J+ Pierson New York University New York, N. Y.
1	Director U.S. Coast & Geodetic Survey Department of Commerce Washington 25, D. C.	1	Director Office of Naval Research 1000 Geary Street San Francisco 9, Calif.
1	Office of Technical Services Department of Commerce Washington 25, D. C.	1	The Oceanographic Institute Florida State University Tallahassee, Florida
1	U.S. Fish & Wildlife Service 450 B Jordon Hall Stanford University Stanford, California	1	Chief of Naval Operations Navy Department Washington 25, D. C. Attn: OP533D
1	U.S. Army Beach Erosion Board 5201 Little Falls Road, N.W. Washington 16, D. C.	1	U. S. Fish & Wildlife Service P. O. Box 3830 Honolulu, T. H.
2	Director Woods Hole Oceanographic Inst. Woods Hole, Mass.	1	Director Narragansett Marine Lab. Kingston, Rhode Island
1	Allen Hancock Foundation University of Southern Calif. Los Angeles 7, California	2	Director Scripps Institution of Ocn. La Jolla, California
1	Head Department of Oceanography University of Washington Seattle, Washington	1	Head Department of Oceanography Brown University Providence, Rhode Island
1	Department of Conservation Cornell University Ithaca, New York Attn: Dr. J. Ayers	1	Director Office of Naval Research 1030 E. Green Street Pasadena 1, Calif.
1	Director Marine Laboratory University of Miami Coral Gables, Florida	1	Director Hawaii Marine Laboratory University of Hawaii Honolulu, T. H.

DISTRIBUTION LIST

<u>No.</u> <u>Copies</u>	<u>Addressee</u>	<u>No.</u> <u>Copies</u>	<u>Addressee</u>
1	Department of Zoology Rutgers University New Brunswick, New Jersey Attn: Dr. H. H. Haskins	1	Director Lamont Geological Observatory Torrey Cliff Palisades, New York
2	Resident Officer in Charge Contract NOy-27474 U.S. Naval Civil Eng. Research and Evaluation Lab. U.S. Naval Const. Battalion Center Port Hueneme, Calif.	5	Armed Services Technical Information Center Documents Service Center Knott Building Dayton 2, Ohio.
1	Director of Regional Office U. S. Weather Bureau Fort Worth, Texas	1	Commanding General Research & Development Div. Department of the Air Force Washington 25, D. C.
1	National Research Council 2101 Constitution Ave. Washington 25, D. C. Attn: Comm. on Undersea Warfare	2	The Pure Oil Company P. O. Box 239 Houston, Texas Attn: Mr. Chase E. Sutton
1	Hydrodynamics Laboratory Calif. Inst. of Technology Pasadena, California Attn: J. E. Carr	1	Dr. L. G. Straub St. Anthony Falls Hydraulic Lab. University of Minnesota Minneapolis 14, Minn.
1	Dr. R. A. Bryson Department of Meteorology University of Wisconsin Madison, Wisconsin	2	The Sun Oil Company San Jacinto Building Beaumont, Texas Attn: Mr. D. D. Braugh
1	U. S. Fish & Wildlife Service Woods Hole, Massachusetts	2	Asst. Naval Attache for Resch. American Embassy Navy 100 Fleet Post Office, New York, N. Y.
2	Geophysics Branch, Code 416 Office of Naval Research Washington 25, D. C.	2	Chief of Naval Research Navy Department Washington 25, D. C. Attn: Codes 466, 446
6	Naval Research Laboratory Technical Services Washington 25, D. C.	3	Director U.S. Naval Electronics Lab. San Diego 52, Calif. Attn: Codes 550, 551, 552
1	Chief, Bureau of Ships Navy Department Washington 25, D. C. Attn: Code 847	1	Commander Naval Ordnance Laboratory White Oak Silver Spring 19, Md.
1	Commanding General Research & Development Div. Department of the Army Washington 25, D. C.		

DISTRIBUTION LIST

<u>No.</u> <u>Copies</u>	<u>Addressee</u>	<u>No.</u> <u>Copies</u>	<u>Addressee</u>
1	Institute of Marine Science The University of Texas Port Aransas, Texas	1	Commandant (OAO) U.S. Coast Guard Washington 25, D. C.
1	Asst. Sec'y of Defense Research & Development Pentagon Building Washington 25, D. C. Attn: Com. Geophysics & Geog.	1	Director Office of Naval Research The John Crerar Library Bldg. 86 E. Randolph St., 10th Floor Chicago 1, Ill.
2	Director U.S. Fish & Wildlife Service Department of Interior Washington, D. C. Attn: Dr. L. A. Walford	1	Commanding Officer Cambridge Field Station 230 Albany Street Cambridge 39, Mass. Attn: CRHSL
1	Director Chesapeake Bay Institute Box 426A, RFD 2 Annapolis, Maryland	1	Director Office of Naval Research 346 Broadway New York 13, N. Y.
1	U.S. Fish & Wildlife Service S. Atlantic Offshore Fishery Invtg. Georgia Game & Fish Comm. P. O. Box 312 Brunswick, Georgia	1	Mr. Francis M. Lucas ONR Resident Representative University of Texas Main Building, Room 2506 Austin 12, Texas
1	Department of Engineering University of California Berkeley, Calif.	1	Office of Naval Research Branch Office 150 Causeway Boston, Massachusetts
1	Office of Naval Research Cont. Adm. Southeastern Area George Washington University 2110 G. St., N. W. Washington 7, D. C.	1	Department of Meteorology Prof. J. Holmboe U. C. L. A. Los Angeles, Calif.
1	Electrical Engr. Research Lab. Attn: J. R. Gerhardt University of Texas Austin, Texas	1	Librarian California Fisheries Lab. Terminal Island Station San Pedro, Calif.
1	Assistant Sec'y for Research & Development Attn: Committee on General Science Department of Defense Washington 25, D. C.		